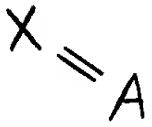
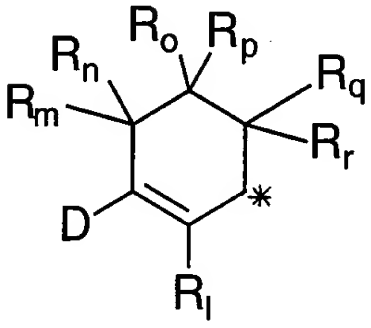
Claims

1. A compound having a formula A:

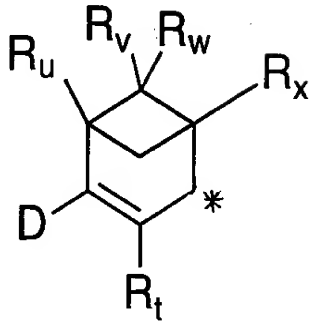


(formula A)

wherein X is selected from the group consisting of

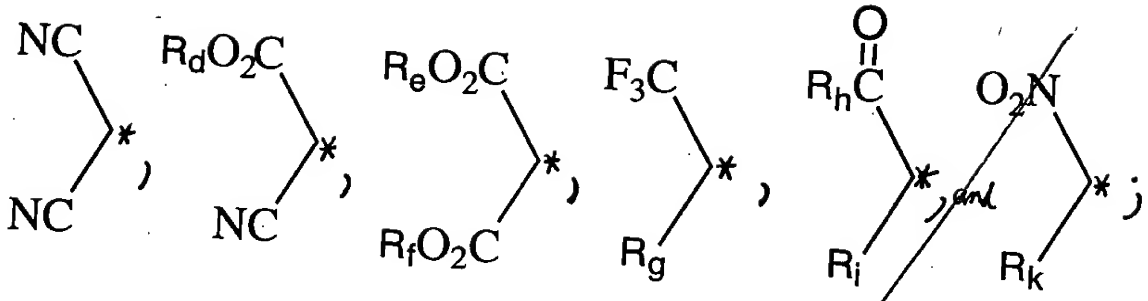


and



wherein D is selected from the group consisting of NR_aR_b, OR_a, SR_a, PR_aR_b, and R_c;

wherein A is selected from the group consisting of:

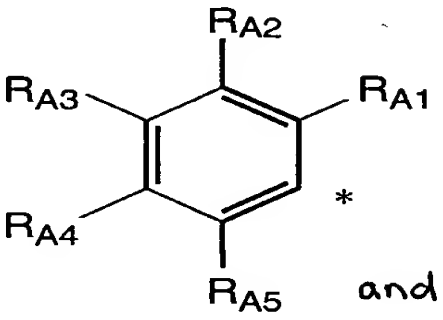


wherein R_a, R_b, and R_c are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic alkyl group; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta OR_{A1}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta NR_{A2}R_{A3}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta CN$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Cl$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Br$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta I$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta$-Phenyl; $-(CH_2)_\alpha(CF_2)_\gamma CF_3$; and an aryl group;

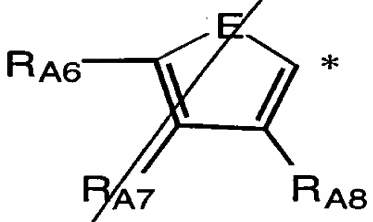
wherein R_d, R_e, R_f, R_l, R_m, R_n, R_o, R_p, R_q, R_r, R_s, R_t, R_u, R_v, R_w, and R_x are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic hydrocarbon group that is saturated or unsaturated; a linear, branched, or cyclic alkyl group; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta OR_{A1}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta NR_{A2}R_{A3}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta CN$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Cl$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Br$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta I$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta$-Phenyl; $-(CH_2)_\alpha(CF_2)_\gamma CF_3$; and an aryl group;

wherein R_g, R_h, R_i, and R_k are the same or different and are each independently selected from the group consisting of: H; a linear, branched, or cyclic hydrocarbon group that is saturated or unsaturated; a linear, branched, or cyclic alkyl group; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta OR_{A1}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta NR_{A2}R_{A3}$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta CN$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Cl$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta Br$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta I$; $-(CH_2CH_2O)_\alpha-(CH_2)_\beta$-Phenyl; an aryl group; $-(CH_2)_\alpha(CF_2)_\gamma CF_3$; $-CO_2R_d$; and $-COR_d$;

wherein each aryl group is optionally independently selected from the group consisting of



and



;

wherein R_{A1}, R_{A2}, R_{A3}, R_{A4}, R_{A5}, R_{A6}, R_{A7}, and R_{A8} are the same or different and are each independently selected from the group consisting of H, a linear alkyl group, a branched alkyl group, and a cyclic alkyl group;

wherein E is selected from the group consisting of S, O, and NR_s;

wherein the alkyl group is optionally substituted or unsubstituted and optionally includes up to 25 carbon atoms;

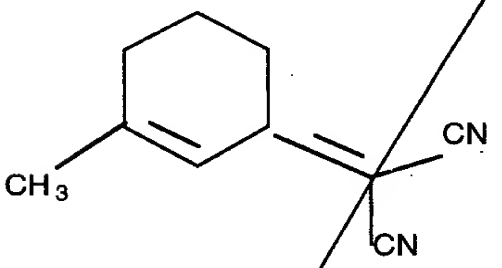
wherein α is an integer that is greater than or equal to 0 and less than or equal to 25;

wherein β is an integer that is greater than or equal to 0 and less than or equal to 25; and

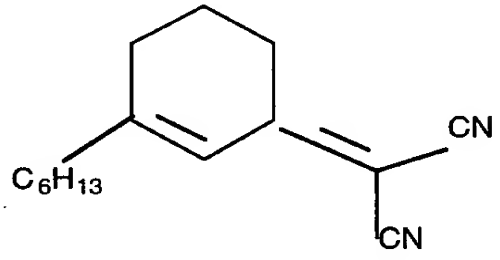
wherein γ is an integer that is greater than or equal to 0 and less than or equal to 25.

2. A compound as claimed in Claim 1, wherein R_l, R_m, R_n, R_o, R_p, R_q, R_r, R_t, R_u, R_v, R_w, and R_x are each H; wherein A is C(CN)(CN); and wherein D is R_y or OR_y, wherein R_y is selected from the group consisting of the linear alkyl group, the branched alkyl group, the cyclic alkyl group, and the aryl group.

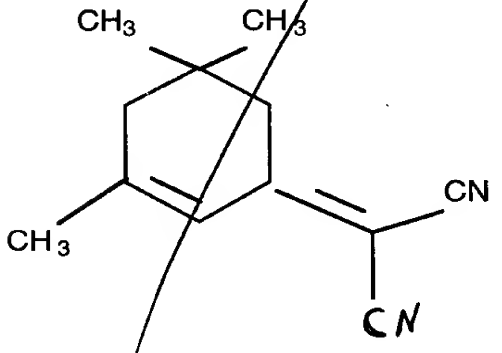
3. A compound as claimed in Claim 1, wherein the compound is selected from the group consisting of



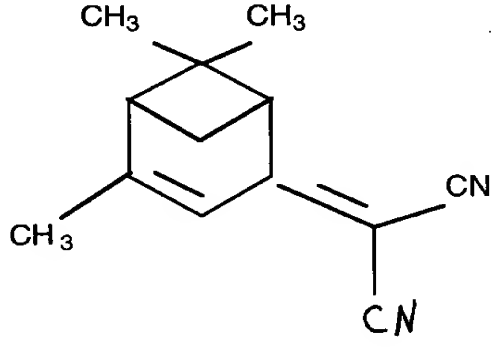
(I)



(II)



(III)



(IV)

4. A liquid-crystal dopant comprising a compound as claimed in Claim 1.

5. A liquid-crystal dopant comprising a compound as claimed in Claim 2.

6. A liquid-crystal dopant comprising a compound as claimed in Claim 3.

7. A liquid-crystal dopant having at about 20-30°C an absorption loss in the visible region of less than or equal to about 5%; having at about 20-30°C a dielectric anistropy of greater than about 50; and having at about 20-30°C a viscosity lower than about 50 centi-poise.

8. A composition comprising a liquid-crystal mixture and a liquid-crystal dopant as claimed in Claim 7, wherein the composition at about 20-30°C has a $\partial n/\partial T$ larger than about 0.005, wherein n is a refractive index of the composition at a visible wavelength and T is a temperature of the composition in °C.

9. A composition comprising a liquid-crystal mixture and a compound as claimed in Claim 1.

10. A composition as claimed in Claim 9, wherein the compound comprises less than or equal to about 50% by weight of the composition.

11. A method for reducing an operation voltage of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

12. A method as claimed in Claim 11, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

SUB A6

13. A method for tuning a clearing temperature of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

14. A method as claimed in Claim 13, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

SUB A6

15. A method for tuning birefringence of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture.

16. A method as claimed in Claim 15, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield a resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

SUB A7

17. A method for increasing a $\partial n/\partial T$ of a liquid-crystal mixture, the method comprising adding the compound claimed in Claim 1 to the liquid-crystal mixture to yield a resulting mixture, wherein the resulting mixture at about 20-30°C has a $\partial n/\partial T$ larger than about 0.005, wherein n is a refractive index of the resulting

mixture and T is a temperature of the resulting mixture in °C.

18. A method as claimed in Claim 17, wherein an amount of the compound is added to and mixed with the liquid-crystal mixture to yield the resulting mixture, wherein the amount of the compound is less than or equal to about 50% by weight of the resulting mixture.

SUB A8

19. A compound as claimed in Claim 1, wherein

wherein when D is NR_aR_b, then α is greater than or equal to 1 and less than or equal to 25;

wherein when R_l, R_m, R_n, R_q, and R_r are each H, and R_o, R_p, and D are each $-CH_3$, A is not C(CN)(CN);

wherein when R_l, R_m, R_n, R_o, and R_p are each H, and R_q, R_r, and D are each $-CH_3$, A is not C(CN)(CN);

wherein when R_l, R_o, R_p, R_q, and R_r are each H, and R_n, R_m, and D are each $-CH_3$, A is not C(CN)(CN); and

wherein when R_l, R_m, R_n, R_o, R_p, R_q, and R_r are each H, and D is $-CH_3$, A is not C(CN)(CN).

20. A composition as claimed in Claim 9, wherein the composition is a liquid-crystal composition.

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